

## Two new freshwater mites of the genus *Limnohalacarus* (Halacaridae: Acari) from Australia

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**Abstract** - From Australia, two new species of the genus *Limnohalacarus* are described. *Limnohalacarus australis* sp. nov. from a sinkhole in the east Kimberley, Western Australia, and *Limnohalacarus billabongis* sp. nov. from Corndorl Billabong, Kakadu National Park, Northern Territory. A key is given to the females of this cosmopolitan genus.

### INTRODUCTION

The superfamily Halacaroidea, with the single family Halacaridae, comprises almost 900 marine and 50 freshwater species, the latter inhabiting both epigeal and hypogean waters (Bartsch, 1996). From Australia, the first record of a freshwater halacarid mite is that of the enigmatic *Astacopsiphagus parasiticus* Viets, 1931, a parasite found fixed to the gills of a parastacid crayfish (Viets, 1931). More than five decades passed by till a second species was added to the fauna of Australia, a species of the widely spread genus *Lobohalacarus*, *L. bunurong* Harvey, 1988, extracted from the sediment of a river bed (Harvey, 1988). Two years later, Harvey (1990) reported on the first Australian representative of *Limnohalacarus*. It is a cosmopolitan genus, known from all continents except Antarctica which has as yet not been studied intensely in respect to its limnic halacarid fauna. In this paper, two species are described, one from the east Kimberley, Western Australia, the other from the Kakadu National Park, Northern Territory.

### MATERIAL AND METHODS

One of the halacarid species was taken by S. M. Eberhard in the course of investigations of caves in the Napier Range, part of the Devonian Reef in the Kimberley, Western Australia. It is a large and highly karstic limestone reef, extending for more than 200 km. The collecting site, in the Donnas Drain, is a water-filled low passage with muddy floor, sediment banks at the waters edge, and many tree roots suspended in the water. The collection was made by sweeping a handnet through the water and amongst the tree roots.

The other species is from Corndorl Billabong, near Jaribu. In the wet season it is a part of the Magela Creek system which flows into the East Alligator River, Kakadu National Park, Northern Territory.

In the dry season (April-October), the Magela Creek contracts into a series of large pools (billabongs), one of those is the Corndorl billabong. The halacarid mites were collected as part of an Environmental Impact Study.

The mites are mounted in glycerine-jelly. One of the holotypes is deposited in the Western Australian Museum, Perth (WAM), the other in the Museum & Art Gallery of the Northern Territory, Darwin (NTM), paratypes are in the NTM, WAM, Senckenberg Museum Frankfurt (SMF), and Zoologisches Institut und Zoologisches Museum, Hamburg (ZMH).

Abbreviations used in the description are: AD, anterior dorsal plate; AE, anterior epimeral plate; GA, genitoanal plate; GP, genital plate; OC, ocular plate(s); P-1 to P-4, first (basal) to fourth (apical) palpal segment; PD, posterior dorsal plate; PE, posterior epimeral plate; sgs, subgenital setae. Legs numbered I to IV.

### SYSTEMATICS

#### Subfamily Limnohalacarinae Viets, 1927

#### Genus *Limnohalacarus* Walter, 1917

#### Type Species

*Limnohalacarus wackeri* (Walter, 1914), by original designation.

#### Diagnosis

AD, OC and PD generally reticulated. Idiosoma with five pairs of gland pores, two or three pairs of dorsal setae and pair of adanal setae. AE with three pairs of ventral setae; PE with three setae. Female GA with three to ten pairs of perigenital setae, male GA with larger number of setae. External acetabula arranged along margins of GA. Gnathosoma with large base. Second pair of long maxillary setae on

rostrum. Palps four-segmented; P-2 enlarged; P-3 with large spine; fourth segment with six setae and a large spine. Tibia III with two bipectinate ventromedial setae. Tarsi I to IV with 1, 0, 0, 0 ventral setae and, with dorsolateral solenidia included, 4, 4, 4, 3 dorsal setae. Tarsi ending with two claws; claws on tarsi II to IV with numerous long lines.

*Limnohalacarus australis* sp. nov.

Figures 1–2

Material Examined

*Holotype*

♀, Donnas Drain (Karst index number KN-42), Kimberley, Western Australia, Australia, 17°15'11"S, 124°41'46"E, 20 July 1998, S. M. Eberhard (WAM 99/2164 BES6166).

Description

*Female*

*Idiosoma* 288 µm long, 205 µm wide. Dorsal plates reticulated, each polygon subdivided. AD rectangular, 75 µm long, 64 µm wide (Figure 1A); pair of gland pores small, placed anterolaterally. Second pair of gland pores ventromarginally, within striated integument between AE and PE (Figure 1B). OC divided transversely; anterior plate rounded, 35–38 µm in diameter; lateral margin with pore canaliculus. Postocular plate slender, triangular, 30 µm long, 11 µm wide; with gland pore anterolaterally. Fourth and fifth pairs of gland pores within striated integument, fourth pair adjacent to insertion of leg IV, fifth pair near posterior margin of PD. PD 176 µm long, 92 µm wide, 1.9 times longer than wide. Dorsal setae small, first pair of setae inserted close together in a raised portion of AD; second pair within striated

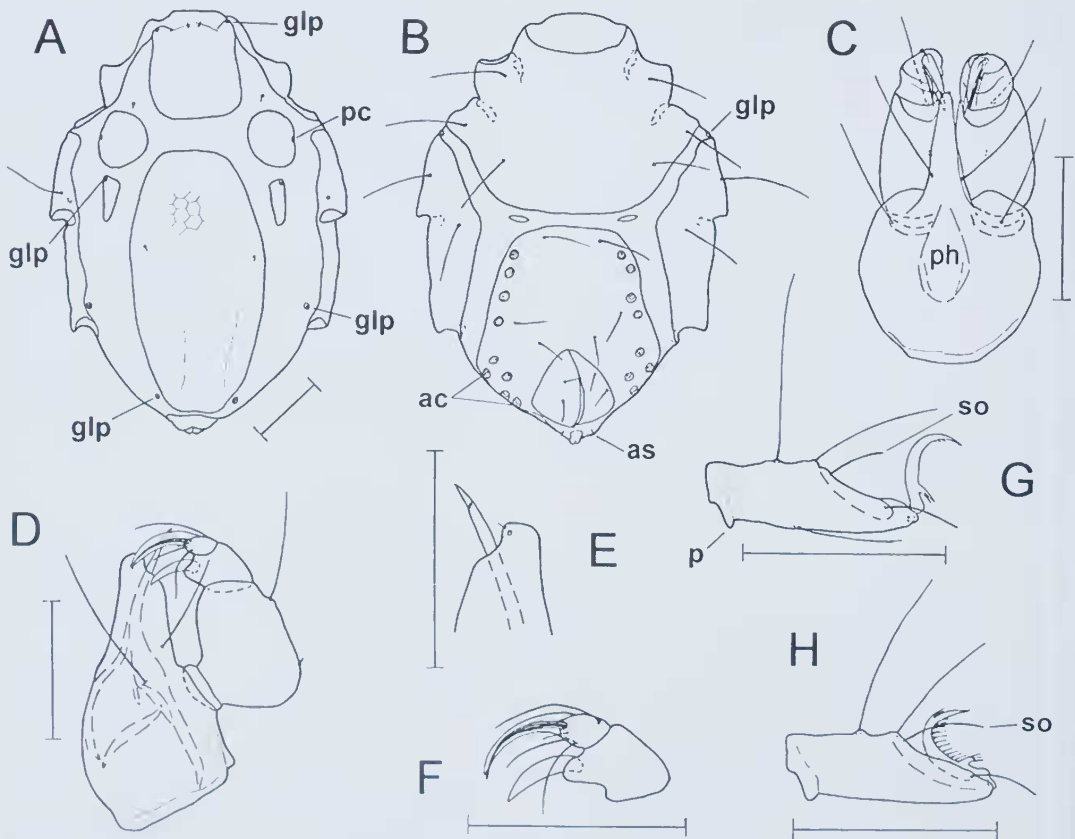


Figure 1 *Limnohalacarus australis* sp. nov., female: A, idiosoma, dorsal aspect; B, idiosoma, ventral aspect; C, gnathosoma, ventral aspect; D, gnathosoma, lateral aspect; E, tip of rostrum and chelicera; F, third and fourth palpal segment, lateral aspect; G, tarsus I, lateral aspect (medial setae and claw omitted); H, tarsus II, lateral aspect (medial setae and claw omitted). (ac, acetabula; as, adanal seta; glp, gland pore; p, basiventral process; pc, pore canaliculus; ph, pharyngeal plate; so, solenidion) Scale lines = 50 µm.

integument anterior to OC; third pair of setae on PD at approximately 0.37 (relative to length of PD, from anterior to posterior) and close to lateral margin. Adanal setae on anal plate seen at ventral aspect (Figure 1B).

Ventral plates delicately porose; marginal areas of PE foveate. AE 110  $\mu\text{m}$  long, 168  $\mu\text{m}$  wide, posterior margin truncate. Pair of platelets posterior to AE (Figure 1B). PE 137  $\mu\text{m}$  long; with one dorsal, one lateral and one ventral seta. GA 147  $\mu\text{m}$  long, 122  $\mu\text{m}$  wide; with eight and nine acetabula along lateral and posterior margin. One of the three pairs of perigenital setae close to anterior margin of GA, the other two pairs of setae slightly anterior to genital opening. Pair of genital sclerites wide, each sclerite with two subgenital setae.

*Gnathosoma* 100  $\mu\text{m}$  long, 63  $\mu\text{m}$  wide, length:width ratio 1.6. Base of gnathosoma globular; rostrum very slender. Pharyngeal plate 34  $\mu\text{m}$  long, 18  $\mu\text{m}$  wide, far from reaching posterior margin of gnathosomal base (Figure 1C). Tip of rostrum narrowed (Figure 1E). Palps extending beyond rostrum (Figure 1D). P-1 short, 5  $\mu\text{m}$  long; P-2 enlarged, along its dorsal margin 45  $\mu\text{m}$  long; P-3

17  $\mu\text{m}$  long and P-4 9  $\mu\text{m}$  long. P-2 with one very short and one long seta. Ventromedial spine of P-3 19  $\mu\text{m}$  long (Figure 1F).

Legs I and II shorter than legs III and IV (Figure 2). Genua I and II shorter than telofemora and tibiae (Figure 2A and B); telofemora I and II about as long as these legs' tibiae. Genua and telofemora of legs III and IV almost equal in length (Figure 2C and D); tibiae III and IV much longer than telofemora III and IV respectively. Integument of lateral flanks of leg segments with epicuticular droplets. Tarsi I to IV each with a basiventral process, dentiform at lateral aspect (Figure 1G). Membranes of claw fossae narrow. Setation of legs, from trochanter to tarsus (parambulacral setae and solenidia included): leg I, 1, 4, 4, 6, 7, 7; leg II, 1, 3, 4, 6, 6, 6; leg III, 1, 2, 3, 4, 7, 6; leg IV, 1, 1, 3, 3, 6, 5. Tibiae I and II each with bipectinate ventromedial seta; tibia III with two strongly bipectinate ventromedial setae; on tibia IV all setae smooth. Solenidion on both tarsus I and II (Figure 1G and H) on dorsolateral membrane of claw fossa, adjacent to dorsal fossary seta. Famulus not seen. All tarsi with pair of single parambulacral setae.

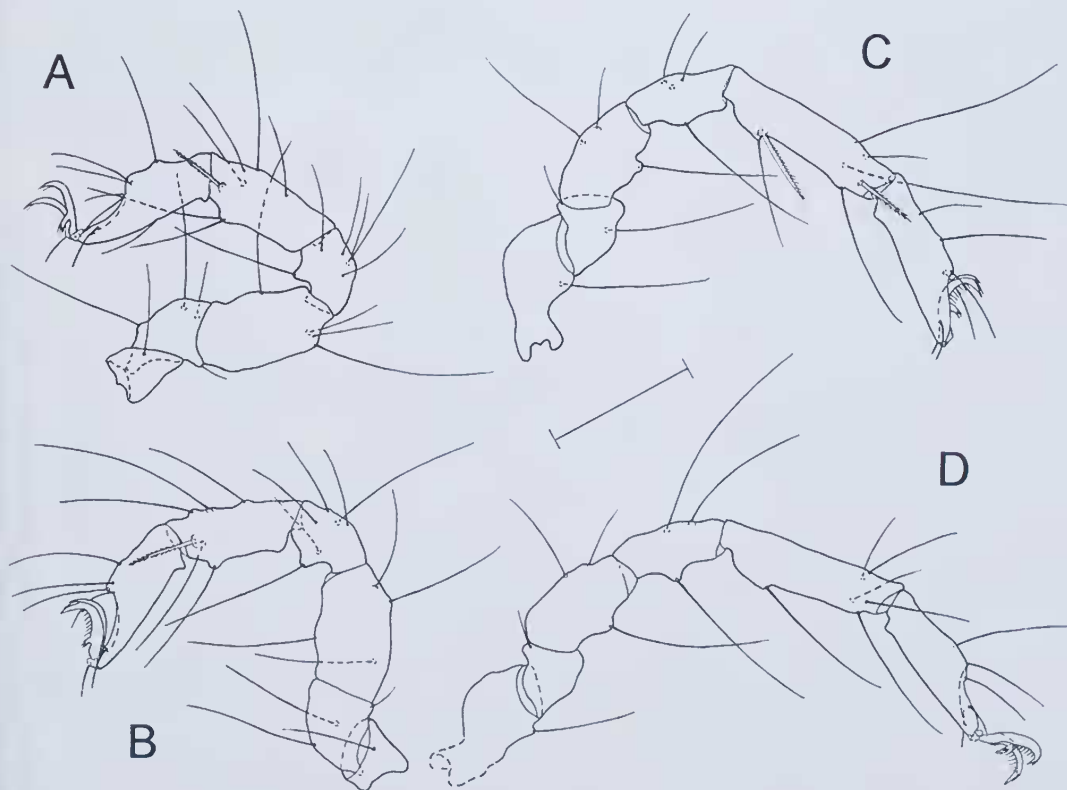


Figure 2 *Limnohalacarus australis* sp. nov., female: A, leg I, medial aspect; B, leg II, medial aspect; C, leg III, medial aspect; D, leg IV, medial aspect (basis of trochanter broken, supplemented by broken line). Scale line = 50  $\mu\text{m}$ .

Tarsi end with pair of claws; each of the claws with basal process. Claws of tarsus I apically with two to three slender tines (Figure 1G); basal process with two tines. Claws on the other tarsi with accessory process and 10–12 tines; basal process with three tines.

#### Remarks

The most marked characters of adult *Limnohalacarus australis* are: ventral plates AE, PE and GP separate, and claws on tarsus I with few small tines and a basal process. The three species *L. africanus* Walter, 1935, *L. capernaumi* Petrova, 1966 and *L. wackeri* (Walter, 1914) have separate ventral plates but differ from *L. australis* by their claws of tarsus I which bear numerous long tines. Two species, *L. cultellatus* Viets, 1940 and *L. inopinatus* Fain and Lambrechts, 1987, are most similar to *L. australis*. *L. australis* has, in contrast to *L. cultellatus*, a larger number of genital acetabula, and the PD of *L. australis*, with a length:width ratio of 1.9, is more slender than that of *L. inopinatus*.

*Limnohalacarus australis* is a western Australian species. *L. cultellatus* was extracted from wells,

ditches and deep crevices on islands of the Lesser Antilles, Caribbean area (Viets, 1940). The homeland of *L. inopinatus* is not known; individuals of the species were found in Belgium, in fish aquaria with cichlids (Fain and Lambrechts, 1987).

#### *Limnohalacarus billabongis* sp. nov.

Figures 3–5

#### Material Examined

##### Holotype

♀, Corndorl Billabong, 12°38'S, 132°53'E, Magela Creek system, Kakadu National Park, Northern Territory, Australia, sample no. PA1, 1 March 1983, M. Malipatil, J. Fysan and A. Sharley (NTM).

##### Paratypes

Australia: Northern Territory: 2 ♀, same data as holotype (NTM); 1 ♀, same data as holotype (WAM 99/2165); 1 ♀, same data as holotype (ZMH).

##### Other Material

Australia: Northern Territory: 3 ♀, same data as

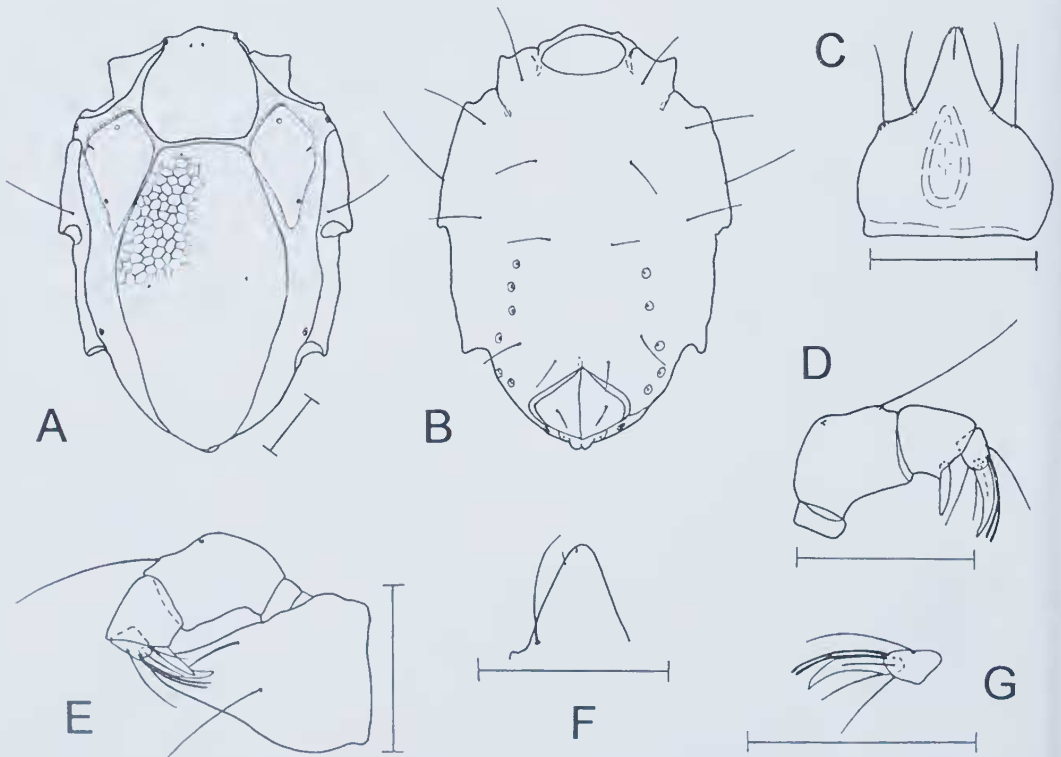


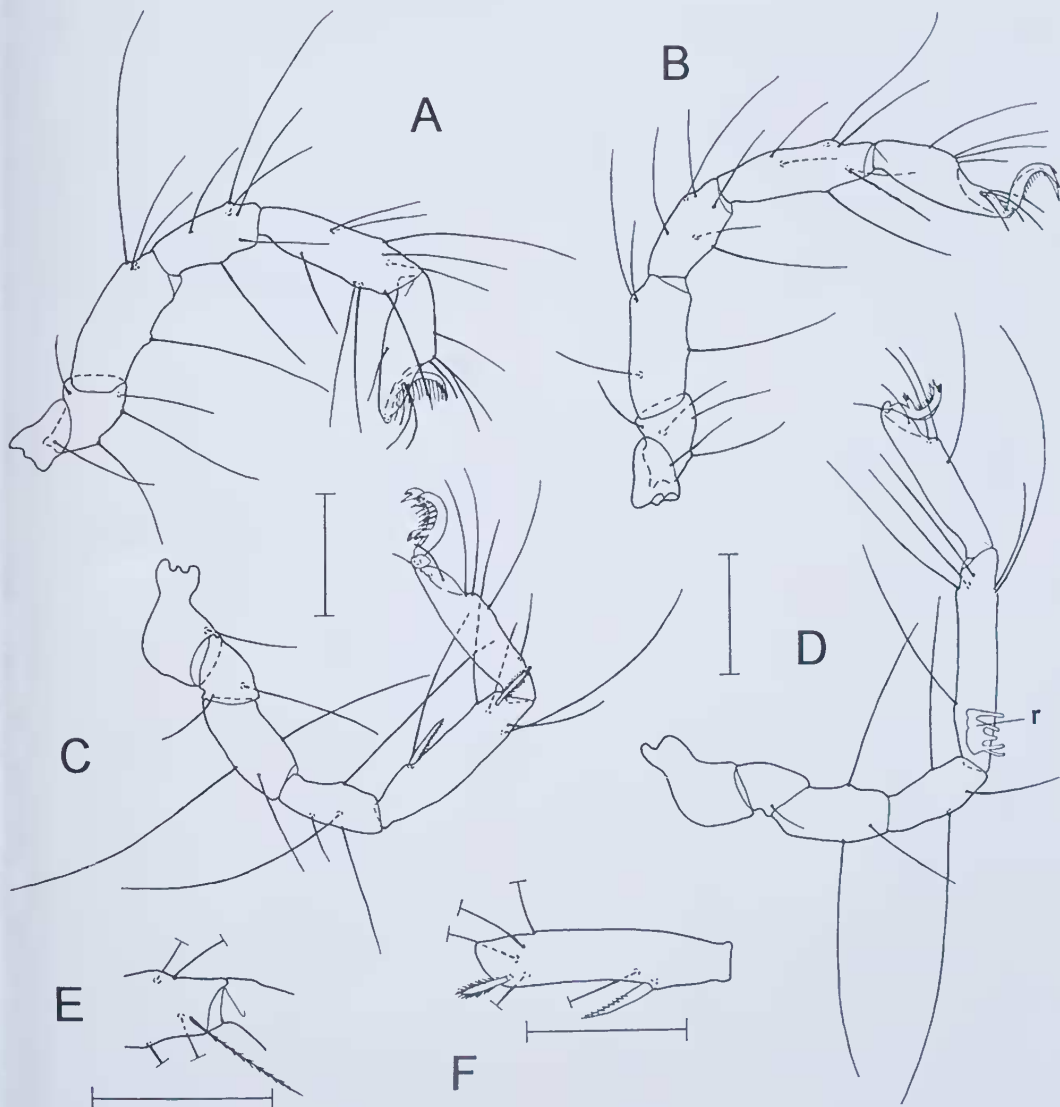
Figure 3 *Limnohalacarus billabongis* sp. nov., female: A, idiosoma, dorsal aspect; B, idiosoma, ventral aspect; C, gnathosoma, ventral aspect; D, palp, medial aspect; E, gnathosoma, lateral aspect; F, tip of rostrum, lateral aspect; G, fourth palpal segment, lateral aspect. Scale line = 50  $\mu$ m.

holotype except sample no. PA2 (NTM, slides); 1 ♀, same data as holotype except sample no. PA3 (NTM, slides); 1 ♀, same data as holotype except sample no. PA4 (NTM, slides); 1 ♀, sample no. PA4 (SMF, slides); 1 deutonymph, same data as holotype except sample no. PA5 (NTM, slides); 1 ♀, 1 deutonymph, same data as holotype except sample no. PB4 (NTM, slides); 12 ♀, Kakadu National Park, Magela Creek system, Corndorl Billabong, 4 and 5 February 1983 (NTM); 8 ♀, 1 deutonymph, Corndorl Billabong, 1 June 1983 (NTM); 4 ♀, same data (author's collection).

### Description

#### Female

*Idiosoma* 297–342 µm long, holotype 320 µm long, 217 µm wide. Dorsal plates delicately porose and reticulated. Spots of black eye pigment present near anterior margin of AD and beneath anterior portion of OC. AD 83 µm long, 91 µm wide. Anterior margin with very small median process and a pair of small lateral protuberances, each with a gland pore. Posterior margin truncate. Second pair of gland pores within striated integument between AE



**Figure 4** *Limnohalacarus billabongis* sp. nov., female: A, leg I, medial aspect; B, leg II, medial aspect; C, leg III, medial aspect; D, leg IV, medial aspect; E, tibia/tarsus II, medial aspect; F, tibia III, medial aspect. (r, remnants of secretion for fixing cocoons) Scale line = 50 µm.

and PE. OC 92  $\mu\text{m}$  long, 51  $\mu\text{m}$  wide (Figure 3A). Plate not divided. Cornea reduced, 2  $\mu\text{m}$  wide, not sharply delimited from surrounding integument. Both pore canaliculus and gland pore within lateral margin of the OC. PD 232  $\mu\text{m}$  long, 132  $\mu\text{m}$  wide, with pair of slightly raised longitudinal costae; their sculpturing same as that of remainder of plate. Anterior margin of plate truncate. Fourth and fifth pairs of gland pores on small platelets within striated integument, fourth pair adjacent to insertion of leg IV, and fifth pair near distal margin of idiosoma, often seen only at ventral aspect. Dorsum with only two pairs of setae, these very short. First pair of setae near anterior margin of AD, the other pair on PD at 0.46 relative to the length of that plate.

All ventral plates fused, this shield 275  $\mu\text{m}$  long. Its integument delicately porose and with a faint reticulation, marginally delicately foveate. Area representing the GA with three pairs of ventral setae and six to seven, rarely up to eight genital acetabula on either side (Figure 3B). Genital sclerites large, with one pair of subgenital setae.

*Gnathosoma* 65  $\mu\text{m}$  long, 58  $\mu\text{m}$  wide, 1.1 times longer than wide (Figure 3C). Rostrum and

gnathosomal base almost equal in length. Rostrum triangular. Basal pair of maxillary setae slender, second pair of setae somewhat thicker. Tip of rostrum with two pairs of rostral setae (Figure 3F). Rostrum almost completely closed dorsally; tectum absent. Pharyngeal plate 30  $\mu\text{m}$  long, not reaching basal margin of gnathosoma. Dorsal length of palpal segments P-1 to P-4: 7, 39, 22, and 13  $\mu\text{m}$  respectively. Apical seta of P-2 long and slender; basal seta generally spur-like (Figure 3D and E), in one of the 10 females studied as long as apical seta. Spine of P-3 12  $\mu\text{m}$  long; spine of P-4 21  $\mu\text{m}$  long (Figure 3G).

Legs slender. Leg IV longest; legs I and III almost equal in length. Tibiae and tarsi lack dentiform basiventral processes. Tibiae I and II slightly longer than these legs' telofemora (Figure 4A and B), tibia III 1.7 times longer than telofemur III (Figure 4C), and tibia IV 1.8 times longer than telofemur IV or almost as long as telofemur plus genu IV (Figure 4D). Tarsi with narrow membranes of claw fossa. Leg chaetotaxy, from trochanter to tarsus (parambulacral setae and solenidia included): leg I, 1, 4, 4, 6, 9, 9; leg II, 1, 4, 4, 6, 7, 8; leg III, 1, 2, 3, 4, 7, 6; leg IV, 0, 1, 3, 3, 6, 5. Ventral setae of tibiae I and

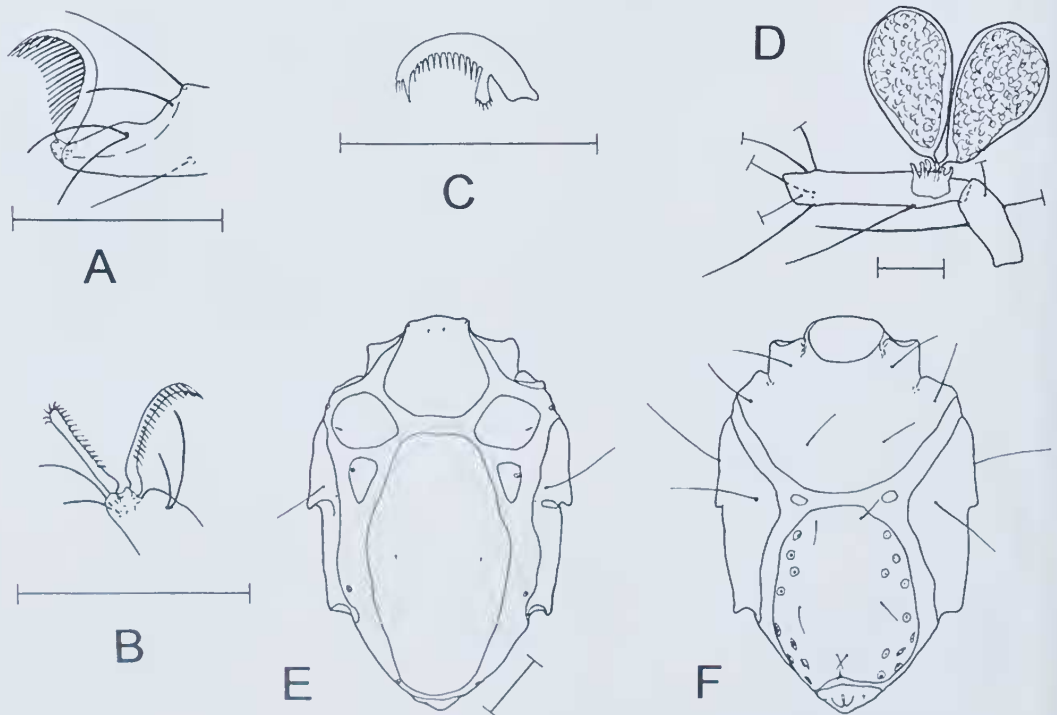


Figure 5 *Limnohalacarus billabongus* sp. nov. A, tip of tarsus I, lateral aspect, female (medial setae and claw omitted); B, tip of tarsus I, ventral aspect, female; C, claw of tarsus IV, female; D, genu and tibia IV and two cocoons, medial aspect, female; E, idiosoma, dorsal aspect, deutonymph; F, idiosoma, ventral aspect, deutonymph. Scale lines = 50  $\mu\text{m}$ .

IV smooth; ventromedial seta of tibia II delicately barbed (Figure 4E). Tibia III with two pairs of ventral setae; the two ventrolateral setae slender and smooth, the ventromedial ones spiniform and coarsely bipectinate (Figure 4F). Tarsi I and II with pair of doubled parambulacral setae, tarsi III and IV with singlets. Solenidion on tarsus I 15 µm long, on tarsus II 20 µm long.

Long, slender claws on tarsus I with J-shaped pecten (Figure 5A and B). Pecten with almost 20 tines; tines 10 µm long. Claws on following legs each with lamellar basal process, that process bearing five to six tines (Figure 5C). Pecten of claws J-shaped, tines shorter than those of tarsus I. Tines on claws III and IV wider than those of leg II.

#### Male

Not seen.

#### Deutonymph

*Idiosoma* 288–295 µm long. AD and PD smaller though in outline similar to plates of female. OC separated into large anterior plate with pore canaliculus and triangular posterior plate with gland pore (Figure 5E). Ventral plates AE, PE, GP, and anal plate separate (Figure 5F). AE, PE, GP each with three pairs of setae. GP with 8–10 pairs of genital acetabula. Anal plate with pair of minute adanal setae.

*Gnathosoma* as in females.

Legs similar to those of females. Setation of legs: leg I, 1, 4, 4, 6, 9, 9; leg II, 1, 3–4, 4, 6, 7, 8; leg III, 1, 2, 3, 4, 7, 6; leg IV, 0, 1, 2, 3, 6, 5.

#### Remarks

*Limnohalacarus billabongis* is characterized by the combination of: idiosoma 300–340 µm long; ventral plates fused to a shield; female genital sclerites with single pair of setae; PD uniformly reticulated, ventral plates finely punctate; OC 1.8 times longer than wide. In the deutonymphs, the OC and the ventral plates are divided; the number of genital acetabula is larger than in females.

Adults of the species from the billabong in the Northern Territory are easily separated from the Western Australian *L. australis* by the large ventral shield. Juveniles can be separated on the basis of the claws on tarsus I, with numerous long tines in *L. billabongis*, with few tines but a basal process in *L. australis*.

Species with a similar ventral shield are *L. fontinalis* Walter and Bader, 1952, *L. lanae* Green, 1976, *L. mamillatus* Fain and Lambrechts, 1987, *L. major* Bader, 1968, and *L. portmanni* Bader, 1967. *L. major* is 450 µm long, *L. portmanni* 250 µm, hence *L. major* is larger, *L. portmanni* smaller than *L. billabongis*. In contrast to *L. billabongis*, females of *L. fontinalis* bear four pairs of setae on the genital

sclerites. The OC of *L. lanae* are shorter (length:width ratio is 1.6) than in *L. billabongis*, and in *L. mamillatus*, the marginal areas of the PE but only lateral portions of the PD have a reticulate ornamentation.

The three species *L. fontinalis*, *L. major* and *L. portmanni* are recorded from Central Africa (Walter and Bader, 1952; Bader, 1967, 1968; Green, 1984). *L. lanae* was taken on Java (Green, 1976) and *L. mamillatus* found in Belgium in fish aquaria with cichlids (Fain and Lambrechts, 1987).

#### Biology

The samples are from February, March and June 1983. None of the 36 adult specimens is a male. The females have cocoons or remnants of their stems fixed to the medial flank of tibiae IV (Figure 5D), each cocoon including a single embryo. The ovoid cocoon is approximately 120 µm long, 90 µm wide, its stem 15–45 µm long. In general, both fourth legs of a female bear a similar number of cocoons, from two till a maximum of 8–9 cocoons per leg.

This form of brood-caring seems to be typical in the genus *Limnohalacarus* (Viets, 1940; Petrova, 1966). Generally, both freshwater and marine species hide their eggs in the substrata inhabited (Teschner, 1963; Kirchner, 1969; Bartsch, 1972).

#### Key to females of *Limnohalacarus*

1. Ventral plates AE, PE and GA fused (Figure 3B) ..... 2
  - Venter with AE, PE and GA separated (Figure 1B) ..... 7
- 2(1). Idiosoma 300–450 µm long ..... 3
  - Idiosoma less than 250 µm long ... *portmanni*
- 3(2). Idiosoma 300–400 µm long. OC not divided ..... 4
  - Idiosoma approximately 450 µm long. OC divided by oblique fissure ..... *major*
- 4(2). Female genital sclerites with one pair of sgs ..... 5
  - Female genital sclerites with four pairs of sgs ..... *fontinalis*
- 5(4). OC slender, at least 1.8 times longer than wide; P-2 with two setae ..... 6
  - OC 1.6 times longer than wide; P-2 with a single seta ..... *lanae*
- 6(5). PD evenly reticulated. Ventral plates delicately punctate but not reticulate .....
  - ..... *billabongis*
  - Lateral portion of PD reticulate, median portion punctate; ventrolateral portion of ventral shield between insertion of legs III and IV reticulate ..... *mamillatus*

- 7(1). Claws on tarsus I with numerous slender tines, tines at least as long as those on posterior claws ..... 8  
 Claws on tarsus I posteriorly with few delicate tines, basally with a process (Figure 1G); Female genital sclerites with two pairs of sgs ..... 10
- 8(7). Each of tarsi I-IV with prominent basiventral process. Tines of pectines on tarsi III and IV similar in size, not on processes ..... 9  
 Ventral margin of tarsi I to IV smooth. Basal tines of pectines on tarsi III and IV on processes ..... *africanus*
- 9(8). Anterior AD with small median process. All setae on tibia IV smooth ..... *wackeri*  
 Anterior margin of AD evenly rounded. Tibia IV with one bipectinate seta ..... *capernaumi*
- 10(7). PD in females slender, more than 1.7 times longer than wide ..... 11  
 Length: width ratio of PD about 1.6 ..... *inopinatus*
- 11(10). Female genital plate with four pairs of genital acetabula ..... *cultellatus*  
 Female genital plate with 8-9 pairs of genital acetabula ..... *australis*

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